Claim R j ctions – 35 U.S.C. 103; Nishino and Hirano

Claims 1-3 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Nishino et al. (JP 407072311A) in view of Hirano et al. (U.S. Patent 5,976,175). Applicants respectfully traverse this rejection.

The references do not teach each and every claimed element

The Office Action alleges that Nishino teaches a semiconductor laser device including a semiconductor laser chip 7 covered with a resin 1a (Figure 5). The Office Action admits that Nishino does not necessarily teach the resin having a light diffusion capability. Instead the Office Action relies on Hirano for teaching a molded resin having a light diffusion capability (column 3, line 61). Further, the Office Action alleges that Hirano teaches other types of laser devices "for the specific purpose of providing safety precautions for laser light in applications to the human body" (Hirano: column 1, line 60, to column 2, line 2, and column 3, lines 55-65).

The present invention is directed to an application requiring emission of a laser light beam directly into space (e.g. wireless communication and sensing). The direct emitting of the laser light beam is done such that it prevents the possibility of damaging a person's eyes. Also the device is designed to reduce the resistance of the light-emitting element for improved reliability, but at the same time is sufficient for simultaneously transmitting and receiving light beams with minimum power consumption. Applicants have determined that by covering the semiconductor laser chip with a molded resin having a light diffusion capability, the safety limits of emitted laser light can be met

while still producing a sufficient laser light beam for purposes of high-speed modulated communication and within minimum power requirements.

Nishino is directed to a light transmitting lens molded out of transparent resin. The lens can be used for transmitting laser light emitted from a semiconductor laser chip 7 (see Figure 5), and in particular is used in a laser radar mounted on a vehicle. The semiconductor laser diode has a large difference between a beam spread angle in the vertical direction and a beam spread angle in the horizontal direction. It is necessary that the light transmitting lens have a compression rate of beam spread angle in the vertical direction that is about 6 times as large as that in the horizontal direction. In order to meet that requirement, the light transmitting lens is obtained by using a combination of one plane-convex cylindrical lens to give a horizontal compression and another plane-convex cylindrical lens to give a vertical compression. The light transmitting lens is held by an inner lens holder 2 which is held by an outer lens holder 3 mounted on a frame 4. The inner lens holder 2 is movable in back and forth direction along the optical axis. Thus, it can be seen that the light transmitting lens does not "cover" the semiconductor laser chip, *per se*. Therefore, Applicants submit that for this reason, Nishino fails to teach at least the claimed, "wherein the semiconductor laser chip is covered with the resin."

Applicants uncovered the nonobvious source of a problem

> It is a well established principle that one may add to the sum of useful knowledge by uncovering the nonobvious source of a

problem and in devising a solution which, though involving a combination of old elements obvious after the source of the problem is isolated, has never before occurred to those skilled in the art. Eibel Process Corp. v. Minnesota & Ontario Paper Co., 261 U.S. 45 (1923);

Hirano

Hirano et al. is directed to a fiber optic laser conducting probe used for therapy for an early cancer. It has been necessary that for relieving pains in a patient during therapy or for increasing the efficiency of the medical treatment, an intense laser beam be rapidly applied to irradiate the same amount of irradiation in the shortest period of time. Thus, Hirano et al. requires an intense high power laser having an end tip for diffusing a pulse laser beam (col. 1, line 67, to col. 2, line 2). Hirano discloses a reliable period of use of about 25 minutes (Figure 10).

In fact, Hirano states as an object to provide a fiber optic laser conducting probe for photodynamic therapy which is stabilized in use even if a pulse wave laser beam having a high energy intensity is applied at a high repetitive frequency and which is high in safety.

The safety aspect of Hirano appears to be in terms of possible error in application of the pulse laser beam due to defective end tip. The defective end tip may produce a non-uniform diffusion of light. For example, Hirano states that, "the damage of end tip due to the rapid application of the laser beam, particularly damage that is injurious to the patient, should be completely avoided." Since the fiber optic laser conducting probe is for insertion into a

body cavity (column 1, lines 9-18), the injuries being prevented at least do not include damage to a person's eyes.

Hirano discloses prior art problems with the end tips of fiber optic laser conducting probes for collecting or diffusing a pulse laser beam. For example, end tips formed of an inorganic material tended to be easily cracked or broken (col. 1, lines 29-34). A tip made of polyacetal resin had the problem of generating formalin, a chemical dangerous to a human body (col. 1, lines 39-42). A tip made of polyolefin resin had a tendency of becoming thermally softened, expanded or bent due to a rise in temperature caused by heating of the laser. In particular, when a pulse laser beam at a high energy level is used, the end tip was denatured due to the energy, which was considered to be due to the short bonding force between molecules of polyolefin long chain molecules (col. 1, lines 43-59; col. 2, lines 18-24).

Hirano's solution to these problems is an end tip made of polyamide resin, particularly for use when a pulse laser wave has an energy of 8mJ/pulse or more and at a high repetitive frequency of 80 Hz or more (col. 2, lines 33-37). The end tip of polyamide resin is disclosed as being applicable as a transparent material used as an optical lens and as an opaque light diffusing material (column 2, lines 60-65). In summary, Hirano's solution is the material composition of the end tip.

Applicants submit that Hirano does not disclose a relationship between light diffusion capability and safety to a persons eyes. Thus, evidence has not been presented that Hirano realized the problem and solution of using light

diffusion to prevent damage to a person's eyes in emitting a laser light beam from a semiconductor laser device.

Nishino is directed to a specific light transmitting lens for use in a radar mounted on a vehicle. The light transmitting lens requires a compression rate of beam spread angle in the vertical direction that is about 6 times as large as that in the horizontal direction. This is necessary in order to illuminate a target that is normally about 8m by 4m, about 100m ahead of the vehicle. The aspect ratio of the illuminated area is necessarily 2 to 1. In order to accomplish these requirements, the light transmitting lens is made up of two cylindrical lenses integrally molded by injection molding of translucent resin. The molding process is necessary in order to avoid degradation of optical performance. Thus, it can be seen that Nishino is concerned with a special light transmitting optical lens and is also not concerned with preventing damage to a person's eyes.

Neither Nishino or Hirano address the problem and solution of the present invention. Accordingly, Applicants submit that it would not have been obvious to one of ordinary skill to use the teachings of Nishino and Hirano, either alone or in combination, in order to solve the problem addressed in the present invention.

Therefore, at least for these reasons, Applicants submit that the rejection fails to establish *prima facie* obviousness for claims 1-3.

Accordingly, Applicants respectfully request that the rejection of claims 1-3 be withdrawn.

Claim R j cti ns – 35 USC 103; Nishin , Hirano, and Claiss

Claims 4 and 7 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Nishino, Hirano, and Claisse et al. (Electronics Letters Vol. 28, No. 21). Applicants respectfully traverse this rejection.

Claim 4 is directed to the invention of claim 1 with the added limitation of a plurality of light emitting portions. Applicants have found that by having a plurality of light emitting portions the resistance of the element is reduced, resulting in a further improvement in the reliability of the semiconductor laser device (Specification, page 22, lines 12-18).

The Office Action relies on Claisse for teaching a plurality of light emitting portions, admitted as missing from Nishino and Hirano. Further, Claisse is relied on for teaching an improvement in internal quantum efficiency of multiple quantum wells over single quantum wells in semiconductor laser chips (Claisse: Figure 2). That teaching is used as a basis for a motivation to combine Claisse with Nishino and Hirano.

At least for the same reasons as above for claim 1, Applicants submit that *prima facie* obviousness has not been established for claims 4 and 7. In addition, Applicants submit that no evidence is provided that shows that Claisse realized the problem and solution of having plural light emitting portions in order to reduce resistance of the element, and thereby improve reliability of the semiconductor laser device. Thus, Applicants submit that no evidence has been provided that one of ordinary skill in the art would have been motivated to include the teachings of Claisse in order to solve the problem

addressed by Applicants. Therefore, Applicants submit that the present claimed invention is a non-obvious solution to a problem not realized by the references. Accordingly, at least for this additional reason, Applicants submit that *prima facie* obviousness has not been established for claims 4 and 7.

Applicants respectfully request that the rejection of claims 4 and 7 be withdrawn.

Claim Rejections – 35 USC 103; Nishino, Hirano, and Hirayama

Claims 5 and 8 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Nishino, Hirano, and Hirayama et al. (U.S. Patent 5,970,081). Applicants respectfully traverse this rejection.

At least for the same reasons as above for claim 1, Applicants submit that *prima facie* obviousness has not been established for claims 5 and 8. Applicants respectfully request that the rejection of claims 5 and 8 be withdrawn.

Claim Rejections – 35 USC 103; Nishino, Hirano, and Andrews

Claims 6, 9, and 20 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Nishino, Hirano, and Andrews (U.S. Patent 5,422,905). Applicants respectfully traverse this rejection.

Claim 6 is directed to the invention of claim 1 with the added limitation of at least one additional semiconductor laser chip. Applicants have found that by having a plurality of semiconductor laser chips, the resistance of the

element is reduced, resulting in a further improvement in the reliability of the semiconductor laser device (Specification, page 22, line 21, to page 23, line 3).

The Office Action relies on Andrews for teaching at least one additional semiconductor laser chip, admitted as missing from Nishino and Hirano. Further, Andrews is relied on for teaching expansion of the technology range of application of semiconductor chips. That teaching is used as a basis for a motivation to combine Andrews with Nishino and Hirano.

At least for the same reasons as above for claim 1, Applicants submit that *prima facie* obviousness has not been established for claims 6, 9, and 20. In addition, Applicants submit that no evidence is provided that shows that Andrews realized the problem and solution of having at least one additional semiconductor chip in order to reduce resistance of the element, and thereby improve reliability of the semiconductor laser device. Thus, Applicants submit that no evidence has been provided that one of ordinary skill in the art would have been motivated to include the teachings of Andrews in order to solve the problem addressed by Applicants. Therefore, Applicants submit that the present claimed invention is a non-obvious solution to a problem not realized by the references. Accordingly, at least for this additional reason, Applicants submit that *prima facie* obviousness has not been established for claims 6, 9, and 20.

Applicants respectfully request that the rejection of claims 6, 9, and 20 be withdrawn.

Claim Rejecti ns – 35 USC 103; Nishin , Hirano, and Okuda

Claims 10 and 11 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Nishino, Hirano, and Okuda (U.S. Patent 6,049,423). Applicants respectfully traverse this rejection.

At least for the same reasons as above for claim 1, Applicants submit that *prima facie* obviousness has not been established for claims 10 and 11.

Further with respect to claim 10, Applicants submit that Okuda does not teach or suggest wherein materials having different refractive indexes are mixed into the resin, or more specifically with respect to claim 11, wherein the materials include transparent epoxy resin and a silica resin, in the context of a resin covering a semiconductor laser chip. The Office Action relies on Okuda for teaching those claimed elements. Furthermore, Applicants submit that one of ordinary skill would not be motivated to combine the teachings of Okuda with Nishino and Hirano.

Nikano is directed to a light transmitting lens molded out of a transparent resin consisting of a plane-convex lens and a piano-convex lens, making the flat surfaces common.

Hirano is directed to a fiber optic laser conducting probe used for therapy for an early cancer. The fiber optic laser produces a pulse wave laser beam having a high energy intensity. A tip of the fiber optic laser is made of nylon resin of polyamide resin in order to prevent denaturing due to the high energy. The fiber tip is roughened so as to make the outgoing light diffuse and uniform (column 4, lines 18-19).

Okuda is directed to a rear projection screen. In particular, the diffusion layer 16 of Okuda serves as part of a lens sheet 10 that receives light of conventional red/green/blue lights.

Applicants submit that it would not have been obvious to one of ordinary skill to incorporate a diffusion layer of Okuda into the light transmitting lens of Nishino. As stated above, Nishino requires a transparent resin for transmitting light through the light transmitting lens. Okuda does not teach materials for a semiconductor laser device.

Applicants submit that it would not have been obvious to one of ordinary skill to incorporate the materials of Okuda into the end tip of Hirano. Hirano discloses materials resulting from various experiments and studies (column 2, lines 10-17). The materials specifically address the problem of thermal softening, expansion, bending, foaming, etc. of the tip that occurs at the high repetitive frequency required of the application that Hirano is directed to (column 2, lines 32-45). There is no evidence in Okuda, which is directed to transmission of conventional light, that the disclosed materials would meet the requirements of Hirano.

Thus, at least for these additional reasons, Applicants submit that the rejection fails to establish *prima facie* obviousness for claims 10 and 11. Accordingly, Applicants respectfully request that the rejection of claims 10 and 11 be withdrawn.

R maining Claim Rej cti ns under 35 USC 103

Claims 12 and 13 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Nishino and Hirano, in view of Andrews, Brooks et al., or Missaggia. Claim 14 has been rejected under 35 U.S.C. 103(a) as being unpatentable over Nishino, Hirano and Claisse, and further in view of Hazell et al. Claims 15 and 17 have been rejected under 35 U.S.C. 103(a) as being unpatentable over either Nishino, Hirano and Andrews, and further in view of Sarraf. Claims 16, 18 and 19 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Nishino, Hirano and Chaisse, as applied to claim 4, and further in view of Kudo et al. At least for the reasons above for claim 1, Applicants submit that the rejections under 35 U.S.C. 103(a) fail to establish *prima facie* obviousness. In addition, each of the above listed claims are directed toward configurations that provide improved reliability in the context of a semiconductor laser device emitting a diffused laser beam that meets safety standards for a person's eyes. None of the above cited references address this problem. Thus, at least for this additional reason, Applicants submit that the present invention addresses a problem with non-obvious solutions, and respectfully request that the rejections be withdrawn.

CONCLUSION

In view of the above amendments and remarks, reconsideration of the various rejections and allowance of claims 1-20 is respectfully requested.

Should the Examiner have any questions concerning this application, the Examiner is invited to contact Robert W. Downs (Reg. No. 48,222) at (703) 205-8000 in the Washington, D.C. area.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully Submitted,

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Translation of Japanese Unexamined Patent Publication

Unexamined Publication No. : JP07-072311A
Date of Publication : March 17, 1995
Application No. : JP05-245995
Date of Filing : September 6, 1993
Applicant(s) : KANSEI CORP.
KODEN ELECTRON CO. LTD
Inventor(s) : Nishino et al.

Title of the Invention:

LIGHT TRANSMITTING LENS OF LASER HEAD

[0001]

[Industrial Field of the Invention]

This invention relates to a light transmission lens of the laser head used for mounted-on-vehicle laser radar especially to a simple and inexpensive light transmission lens.

[0002]

[Description of the Prior Art]

A laser radar is used as one of the radar mounted on a vehicle. This laser radar is for detecting a distance to a target such as another vehicle ahead, which comprises a laser head to emit a pulse laser light constituted by a semiconductor laser diode and a light transmitting lens and a light receiving unit including a light receiving element such as avalanche photo-diode to detect the pulse laser light reflected by the target to measure the time from emitting the pulse light to detecting the reflected light so that a distance between the laser radar and the target can be obtained by multiplying* a half of the time by a velocity of the laser light.

* Translator's note: In the specification, description says dividing a half of the time by a velocity of the laser light. But it must be wrong.

[0003]

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The semiconductor laser diode has a large difference between a beam spread angle in the vertical direction and a beam spread angle in the horizontal direction, i.e., typically about 30 ° in vertical direction and about 10° in horizontal direction. However target area to be detected, i.e., area to be illuminated is normally about 8m (in horizontal direction) by 4m (in vertical direction) about 100m ahead. To make the landscape illuminated area with aspect ratio of 2 to 1 about 100m ahead, we need to have a special light transmitting optical system of which a compression rate of beam spread angle

in the vertical direction is about 6 times as large as that in the horizontal direction.

* * * * *

[0005]

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It (a special light transmitting optical system) can be obtained by using a combination of one plane-convex cylindrical lens 52 to give a horizontal compression and another plane-convex cylindrical lens 51 to give a vertical compression of which compression rate is different from the horizontal one.

[0006]

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As shown in FIG.9 (C), the cylindrical lenses 51 and 52 can be integrally molded by injection molding, which is preferable in terms of reducing assembling process and avoiding a degradation of optical performance due to separation and loss of light by reflection arising at adhesive-bonded interface of two plane-convex cylindrical lens 51 and 52.

[0007]

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However, this integrally molded structure requires increase of its total thickness, which leads to difficulty in keeping high accuracy of shape.

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[0010]

An object of the invention is to provide a light transmitting lens with less thickness for a laser head, which enables to use an integrally molding process by injection molding of translucent resin

[0011]

A light transmitting lens of the invention for a laser head to accomplish the object is obtained by integrally forming using injection molding of translucent resin , the integrally formed lens consists of plane-convex lens part and plane-convex or

plane-concave cylindrical lens part of which plane surfaces are in common.

[0012]

[Function] According to the invention, a vertical spread angle and a horizontal spread angle of the beam emitted from the semiconductor laser are compressed by the plane-convex lens part equally in both vertical and horizontal directions so as to satisfy the horizontal compression requirement to compress about 10 ° spread angle of the beam into a several degree angle. As the compression in the vertical direction is not enough because original vertical spread angle is about 30°, further compression only in the vertical direction is made by the plane-convex cylindrical lens part to make up. According to another example of the invention, the plane-convex lens part is designed to satisfy the vertical compression requirement to compress about 30 ° spread angle of the beam into a several degree angle. As the compression in the horizontal direction, however, is more than requirement because original horizontal spread angle is about 10°, expansion of spread angle of the beam in the horizontal direction is made by the plane-concave cylindrical lens to make up so as to finally obtain a several degree spread angle.

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[0019]

FIG.4 is a perspective view of a light transmitting lens of another laser head of the invention. This light transmitting lens is manufactured by injection molding so as to form a integral combination of a plane-convex lens part 1-a and a plane-convex cylindrical lens part 1-b of which plane surfaces are in common. Slits as light absorbing layer are printed by screen printing on the peripheral part of curved surface of the plane-convex cylindrical lens part 1-b. - - - - - - - - .

[0020]

FIG.5 is a cross section showing the configuration of a main portion of the laser head of a mounted-on-vehicle laser radar

using the integrally molded light transmission lens 1 shown in FIG.4. The integrally molded light transmission lens 1 constituted by the plane-convex lens part 1-a and a plane-convex cylindrical lens part 1-b is held by an inner lens holder 2 which is held by an outer lens holder 3 mounted on a frame 4. The inner lens holder 2 is movably mounted in back and forth direction along the optical axis, the final adjusted position is fixed by a screw 6. A protective glass 5 is disposed in front of the outer lens holder 3. A semiconductor laser diode 7 in a housing mounted on a print circuit board 8 is disposed behind the light transmitting lens 1.

[0021]

One example of designed laser head of FIG.5 has a performance capable of compressing a spread angle of a beam into 1.7 ° in the vertical direction and 2.7 ° in the horizontal direction to make the landscape illuminated area with aspect ratio of 2 to 1 ahead of the head, wherein an original spread angle of the beam from the semiconductor laser diode is 30 ° in the vertical direction and 10 ° in the horizontal direction.

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[0031]

In the above description, explanation is made with respect to examples of the light transmission lens, constituted by the plane-convex lens part and a cylindrical lens part, which is formed integrally by injection-molding translucent resin. Needless to say, the lens system can also be formed by bonding a plane-convex lens and a cylindrical lens, each of lenses are separately made of translucent resin or glass, at their flat planes by adhesives or the like.

[0032]

Also in the above, the lens system applied to laser head of mounted-on-vehicle laser radar is described. It is, however, also clear that a laser head using a light transmitting lens of the invention can be used for another appropriate purpose, for

example, as a laser head for projecting an approximately parallel laser beam with desired beam section shape onto the objective lens of an optical reader.

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